

# OBSERVATIONS & RECOMMENDATIONS

After reviewing data collected from **PAWTUCKAWAY LAKE, NOTTINGHAM**, the program coordinators have made the following observations and recommendations.

Thank you for your continued hard work sampling the lake this year! As you know, conducting multiple sampling events each year enables DES to more accurately detect water quality changes. Keep up the good work!

As a result of internal and watershed phosphorus loading to **PAWTUCKAWAY LAKE**, algal blooms and cyanobacteria blooms are occurring more frequently in the lake. Cyanobacteria blooms have caused Pawtuckaway Lake to be listed as impaired and not meeting state water quality standards.

To reduce the frequency and severity of algal blooms and cyanobacteria blooms, phosphorus loading to the lake from watershed runoff must be managed. In 2006, the Town of Nottingham, with support of the Pawtuckaway Advisory Committee and Pawtuckaway Lake Improvement Association, received a DES local watershed initiative grant to assist with this process. Pollutant load allocation will occur through the development of a watershed based plan. In addition, several shoreline properties will be selected for landscape best management practice (BMP) design and implementation targeted at reducing stormwater runoff rates and volumes. GeoSyntec, Inc. was selected by DES to assist with development of the watershed based plan and BMP design. The Town of Nottingham has offered time and materials assistance to construct the BMPs.

In addition to the watershed based plan and BMP design and implementation, the town will lead an education campaign targeting landowners within the watershed about their individual impact on the watershed, stormwater runoff, and the lake. This will be accomplished through development and distribution of a Waterfront and Watershed Property Owner's Brochure.

#### FIGURE INTERPRETATION

- **Figure 1 and Table 1:** Figure 1 in Appendix A shows the historical and current year chlorophyll-a concentration in the water column. Table 1 in Appendix B lists the maximum, minimum, and mean concentration for each sampling year that the lake has been monitored through VLAP.

Chlorophyll-a, a pigment found in plants, is an indicator of the algal abundance. Because algae are usually microscopic plants that contain chlorophyll-a, and are naturally found in lake ecosystems, the chlorophyll-a concentration measured in the water gives an estimation of the algal concentration or lake productivity. **The median summer chlorophyll-a concentration for New Hampshire's lakes and ponds is 4.58 mg/m<sup>3</sup>.**

#### North and South Deep Spot Stations

The current year data (the top graph) show that the chlorophyll-a concentration at both deep spots **decreased greatly** from **June** to **July**, **increased** from **July** to **August**, and then **decreased** from **August** to **September**. The **elevated** chlorophyll concentration in **June** indicated that an **algal bloom** had occurred.

The historical data (the bottom graph) show that the **2006** chlorophyll-a mean at both deep spots is **greater than** the state median and the similar lake median. For more information on the similar lake median, refer to Appendix F.

Overall, visual inspection of the historical data trend line (the bottom graph) for both deep spots shows a **variable**, but **overall increasing (meaning worsening)**, chlorophyll-a trend since monitoring began.

In the **2007** biennial annual report, since both deep spots will have been sampled for at least **ten** consecutive years for chlorophyll, we will conduct a statistical analysis of the historical data to objectively determine if there has been a significant change in the annual mean chlorophyll-a concentration since monitoring began. Please refer to Appendix E for a detailed statistical analysis explanation.

While algae are naturally present in all lakes, an excessive or increasing amount of any type is not welcomed. In freshwater lakes, phosphorus is the nutrient that algae typically depend upon for growth in New Hampshire lakes. Algal concentrations may increase as nonpoint sources of phosphorus from the watershed increase, or as in-lake phosphorus sources increase. Therefore, it is extremely important for volunteer monitors to continually educate all watershed

residents about management practices that can be implemented to minimize phosphorus loading to surface waters.

- **Figures 2a and 2b and Tables 3a and 3b:** Figure 2a in Appendix A shows the historical and current year data for transparency without the use of a viewscope and Figure 2b shows the current year data for transparency with the use of a viewscope. Table 3a in Appendix B lists the maximum, minimum and mean transparency data without the use of a viewscope and Table 3b lists the maximum, minimum and mean transparency data with the use of a viewscope for each year that the lake has been monitored through VLAP.

Volunteer monitors use the Secchi disk, a 20 cm disk with alternating black and white quadrants, to measure how far a person can see into the water. Transparency, a measure of water clarity, can be affected by the amount of algae and sediment in the water, as well as the natural color of the water. **The median summer transparency for New Hampshire's lakes and ponds is 3.2 meters.**

#### **North and South Deep Spot Stations**

The current year data (the top graph) show that the non-viewscope in-lake transparency at both deep spots **increased** from **June** to **July**, **decreased** from **July** to **August**, and **increased** from **August** to **September**.

It is important to note that as the chlorophyll concentration at both deep spots **decreased** from **June** to **July**, the transparency **increased**; as the chlorophyll **increased** from **July** to **August**, the transparency **decreased**, and; as the chlorophyll **decreased** from **August** to **September**, the transparency **increased**. We typically expect this **inverse** relationship in lakes. As the amount of algal cells in the water **decreases**, the depth to which one can see into the water column typically **increases**, and vice-versa.

The historical data (the bottom graph) show that the **2006** mean non-viewscope transparency at both deep spots is **approximately equal to** the state median and is **much less than** the similar lake median. Please refer to Appendix F for more information about the similar lake median.

The transparency was **not** measured with the viewscope during 2006. As discussed previously, a comparison of transparency readings taken with and without the use of a viewscope shows that the viewscope typically increases the depth to which the Secchi disk can be seen into the lake, particularly on sunny and windy days. We recommend that your group measure Secchi disk transparency with and without the viewscope on each sampling event.

Overall, visual inspection of the historical data trend line (the bottom graph) for both deep spots shows a ***variable, but overall slightly decreasing (meaning worsening)***, trend for in-lake non-viewscope transparency since monitoring began.

In the **2007** biennial annual report, since both deep spots will have been sampled for at least **ten** consecutive years for transparency, we will conduct a statistical analysis of the historical data to objectively determine if there has been a significant change in the annual mean chlorophyll-a concentration since monitoring began. Please refer to Appendix E for a detailed statistical analysis explanation.

Typically, high intensity rainfall causes sediment-laden stormwater runoff to flow into surface waters, thus increasing turbidity and decreasing clarity. Efforts should continually be made to stabilize stream banks, lake shorelines, disturbed soils within the watershed, and especially dirt roads located immediately adjacent to the edge of tributaries and the lake. Guides to best management practices that can be implemented to reduce, and possibly even eliminate, nonpoint source pollutants, are available from DES upon request.

- **Figure 3 and Table 8:** The graphs in Figure 3 in Appendix A show the amount of epilimnetic (upper layer) phosphorus and hypolimnetic (lower layer) phosphorus; the inset graphs show current year data. Table 8 in Appendix B lists the annual maximum, minimum, and median concentration for each deep spot layer and each tributary since the lake has been sampled through VLAP.

Phosphorus is typically the limiting nutrient for plant and algae growth in New Hampshire's lakes and ponds. Excessive phosphorus in a lake can lead to increased plant and algal growth over time. **The median summer total phosphorus concentration in the epilimnion (upper layer) of New Hampshire's lakes and ponds is 12 ug/L. The median summer phosphorus concentration in the hypolimnion (lower layer) is 14 ug/L.**

#### **North Deep Spot Station**

The current year data for the epilimnion (the top inset graph) show that the phosphorus concentration ***decreased*** from **June** to **July**, ***increased*** from **July** to **August**, and ***remained stable*** from **August** to **September**.

The historical data show that the **2006** mean epilimnetic phosphorus concentration is ***greater than*** the state median and the similar lake median. Refer to Appendix F for more information about the similar lake median.

The current year data for the hypolimnion (the bottom inset graph) show that the phosphorus concentration **increased steadily** from **June** to **August**, and then **decreased slightly** from **August** to **September**.

The turbidity of the hypolimnion (lower layer) sample was **elevated** on the **July, August** and **September** sampling events (**8.31, 12.0, and 6.79 NTUs, respectively**). In addition, the hypolimnetic turbidity at this deep spot has been **at least slightly elevated** on most sampling events during previous years. This suggests that the lake bottom is covered by a thick organic layer of sediment which is easily disturbed. When the lake bottom is disturbed, sediment, which typically contains attached phosphorus, is released into the water column. When collecting the hypolimnion sample, make sure that there is no sediment in the Kemmerer Bottle before filling the sample bottles.

The historical data show that the **2006** mean hypolimnetic phosphorus concentration is ***much greater than*** the state median and the similar lake median. Please refer to Appendix F for more information about the similar lake median.

Overall, visual inspection of the historical data trend line for the epilimnion shows a ***variable, but slightly increasing (meaning worsening)***, phosphorus trend since monitoring began in **1988**.

Overall, visual inspection of the historical data trend line for the hypolimnion shows a ***variable, but overall increasing (meaning worsening)***, phosphorus trend since monitoring began in **1988**.

#### **South Deep Spot Station**

The current year data for the epilimnion (the top inset graph) show that the phosphorus concentration **decreased slightly** from **June** to **July**, **increased** from **July** to **August**, and **decreased** from **August** to **September**.

The historical data show that the **2006** mean epilimnetic phosphorus concentration is ***slightly greater than*** the state median and is ***greater than*** the similar lake median. Refer to Appendix F for more information about the similar lake median.

The current year data for the hypolimnion (the bottom inset graph) show that the phosphorus concentration **increased gradually** from **June** to **September**.

The turbidity of the hypolimnion (lower layer) sample was **slightly elevated** on the **July, August**, and **September** sampling events (**2.36, 3.8, and 2.04 NTUs, respectively**). This suggests that the lake

bottom may have been disturbed by the anchor or by the Kemmerer Bottle while sampling and/or that the lake bottom is covered by a thick organic layer of sediment which is easily disturbed.

The historical data show that the **2006** mean hypolimnetic phosphorus concentration is ***slightly greater than*** the state median and the similar lake median. Please refer to Appendix F for more information about the similar lake median.

Overall, visual inspection of the historical data trend line for the epilimnion and hypolimnion shows a ***variable*** phosphorus trend since monitoring began in **1992**.

As discussed previously, in the **2007** biennial annual report, since both deep spots will have been sampled for phosphorus for at least **ten** consecutive years, we will conduct a statistical analysis of the historical data to objectively determine if there has been a significant change in the annual mean phosphorus concentration since monitoring began.

One of the most important approaches to reducing phosphorus loading to a waterbody is to continually educate watershed residents about the sources of phosphorus in a watershed and how excessive phosphorus loading can negatively affect the ecology and the recreational, economical, and ecological value of lakes and ponds.

#### TABLE INTERPRETATION

##### ➤ **Table 2: Phytoplankton**

Table 2 in Appendix B lists the current and historical phytoplankton species observed in the lake. Specifically, this table lists the three most dominant phytoplankton species observed in the sample and their relative abundance in the sample.

	<b>North Deep Spot</b>	<b>South Deep Spot</b>
<b>6/13/06</b>	<i>Synura</i> (golden-brown) <i>Asterionella</i> (diatom) <i>Mallomonas</i> (golden-brown)	<i>Synura</i> (golden-brown) <i>Asterionella</i> (diatom) <i>Mallomonas</i> (golden-brown)
<b>7/18/06</b>	<i>Tabellaria</i> (diatom) <i>Ceratium</i> (dinoflagellate) <i>Synura</i> (golden-brown)	<i>Synura</i> (golden-brown) <i>Tabellaria</i> (diatom) <i>Ceratium</i> (dinoflagellate)
<b>8/8/06</b>	<i>Synura</i> (golden-brown) <i>Anabaena</i> (cyanobacteria) <i>Ceratium</i> (dinoflagellate)	<i>Oscillatoria</i> (cyanobacteria) <i>Synura</i> (golden-brown) <i>Dinobryon</i> (golden-brown)
<b>9/12/06</b>	<i>Cosmarium</i> (green) <i>Coelosphaerium</i> (cyanobacteria) <i>Merismopedia</i> (cyanobacteria)	<i>Cosmarium</i> (green) <i>Merismopedia</i> (cyanobacteria) <i>Anabaena</i> (cyanobacteria) <i>Mallomonas</i> (golden-brown)

Thank you for collecting phytoplankton samples on each sampling event this season. We recommend that your group continue to collect monthly phytoplankton samples so that we may better understand why certain species become dominant under certain conditions.

Phytoplankton populations undergo a natural succession during the growing year. Please refer to the “Biological Monitoring Parameters” section of this report for a more detailed explanation regarding yearly plankton succession. Diatoms and golden-brown algae are typical in New Hampshire’s less productive lakes and ponds.

➤ **Table 2: Cyanobacteria**

The cyanobacteria **Anabaena** was one of the most dominant species in the **North** deep spot plankton sample in **August** and the **South** deep spot sample in **September**. The cyanobacteria **Oscillatoria** was the most dominant species observed in the **South** deep spot sample in **August**. In addition, a small amount of **Anabaena** was observed in the **North** and **South** deep spot samples in **July** and **September**. Furthermore, the cyanobacteria **Microcystis** was observed in small amounts in the **North** and **South** deep spot samples in **September**. ***These species, if present in large amounts, can be toxic to livestock, wildlife, pets, and humans.*** Please refer to the “Biological Monitoring Parameters” section of this report for a more detailed explanation regarding cyanobacteria.

Cyanobacteria can reach nuisance levels when phosphorus loading from the watershed to surface waters is increased and favorable environmental conditions occur, such as a period of sunny, warm weather.

The presence of cyanobacteria serves as a reminder of the lake’s delicate balance. Watershed residents should continue to act proactively to reduce nutrient loading to the lake by eliminating fertilizer use on lawns, keeping the lake shoreline natural, re-vegetating cleared areas within the watershed, and properly maintaining septic systems and roads.

In addition, residents should also observe the lake in September and October during the time of fall turnover (lake mixing) to document any algal blooms that may occur. Cyanobacteria have the ability to regulate their depth in the water column by producing or releasing gas from vesicles. However, occasionally lake mixing can affect their buoyancy and cause them to rise to the surface and bloom. Wind and currents tend to “pile” cyanobacteria into scums that accumulate in one section of the lake. If a fall bloom occurs, please collect a sample in any clean jar or bottle and contact the VLAP Coordinator.

➤ **Table 4: pH**

Table 4 in Appendix B presents the in-lake and tributary current year and historical pH data.

pH is measured on a logarithmic scale of 0 (acidic) to 14 (basic). pH is important to the survival and reproduction of fish and other aquatic life. A pH below 6.0 typically limits the growth and reproduction of fish. A pH between 6.0 and 7.0 is ideal for fish. The median pH value for the epilimnion (upper layer) in New Hampshire's lakes and ponds is **6.6**, which indicates that the surface waters in the state are slightly acidic. For a more detailed explanation regarding pH, please refer to the "Chemical Monitoring Parameters" section of this report.

The mean pH at the deep spot this year ranged from **6.02** in the hypolimnion to **6.49** in the epilimnion at the **North** deep spot, and from **6.00** in the hypolimnion to **6.58** in the epilimnion at the **South** deep spot which means that the water is *slightly acidic*.

It is important to point out that the pH in the hypolimnion (lower layer) was *lower (more acidic)* than in the epilimnion (upper layer). This increase in acidity near the lake bottom is likely due to the decomposition of organic matter and the release of acidic by-products into the water column.

Due to the presence of granite bedrock in the state and acid deposition received from snowmelt, rainfall, and atmospheric particulates, there is not much that can be feasibly done to effectively increase lake pH.

➤ **Table 5: Acid Neutralizing Capacity**

Table 5 in Appendix B presents the current year and historical epilimnetic ANC for each year the lake has been monitored through VLAP.

Buffering capacity (ANC) describes the ability of a solution to resist changes in pH by neutralizing the acidic input. The median ANC value for New Hampshire's lakes and ponds is **4.9 mg/L**, which indicates that many lakes and ponds in the state are at least "moderately vulnerable" to acidic inputs. For a more detailed explanation about ANC, please refer to the "Chemical Monitoring Parameters" section of this report.

The mean acid neutralizing capacity (ANC) of the epilimnion (upper layer) was **3.9 mg/L** at the **North** deep spot and **4.1 mg/L** at the



**South** deep spot, both of which are **less than** the state median. In addition, this indicates that the lake is **moderately vulnerable** to acidic inputs.

➤ **Table 6: Conductivity**

Table 6 in Appendix B presents the current and historical conductivity values for tributaries and in-lake data. Conductivity is the numerical expression of the ability of water to carry an electric current, which is determined by the number of negatively charged ions from metals, salts, and minerals in the water column. The median conductivity value for New Hampshire's lakes and ponds is **40.0 uMhos/cm**. For a more detailed explanation, please refer to the "Chemical Monitoring Parameters" section of this report.

The mean annual epilimnetic conductivity at the **North** deep spot this year was **34.78 uMhos/cm**, and at the **South** deep spot was **36.54 uMhos/cm**, both of which are **slightly less than** the state median.

The **2006** conductivity results for both deep spots and most of the tributaries were **lower than** has been measured **during the past few years**. It is likely that the high water levels during **2006** diluted the ion concentration in surface waters throughout the watershed. Specifically, the unusually large amount of watershed runoff from the significant late spring rain events likely exceeded the amount of groundwater contribution to the tributaries and lake. In addition, any winter contribution of chloride to surface waters from road salt was likely flushed out of the tributaries and the lake before the lake stratified during the summer.

Overall, the conductivity has **gradually increased** in the lake and inlets since monitoring began. In addition, the conductivity has **remained elevated** at **Fernalds A**, **Fernalds B**, and **White Grove Brook**. Typically, increasing conductivity indicates the influence of pollutant sources associated with human activities. These sources include failed or marginally functioning septic systems, agricultural runoff, and road runoff which contains road salt during the spring snow-melt. New development in the watershed can alter runoff patterns and expose new soil and bedrock areas, which could also contribute to increasing conductivity. In addition, natural sources, such as iron and manganese deposits in bedrock, can influence conductivity.

We recommend that your monitoring group conduct stream surveys and rain event sampling along the tributaries with **elevated** conductivity so that we can determine potential sources to the lake.

*For a detailed explanation on how to conduct rain event sampling and stream surveys, please refer to the 2002 VLAP Annual Report special topic article, which is posted on the VLAP website at [http://www.des.nh.gov/wmb/vlap/2002/documents/Appndxd\\_monitoring.pdf](http://www.des.nh.gov/wmb/vlap/2002/documents/Appndxd_monitoring.pdf), or contact the VLAP Coordinator.*

We also recommend that your monitoring group conduct a shoreline conductivity survey of the lake and the tributaries with **elevated** conductivity to help identify the sources of conductivity.

*To learn how to conduct a shoreline or tributary conductivity survey, please refer to the 2004 special topic article, which is posted on the VLAP website at [http://www.des.nh.gov/wmb/vlap/2004/documents/Appendix\\_D.pdf](http://www.des.nh.gov/wmb/vlap/2004/documents/Appendix_D.pdf) or contact the VLAP Coordinator.*

It is possible that de-icing materials applied to nearby roadways during the winter months may be influencing the conductivity in the lake. In New Hampshire, the most commonly used de-icing material is salt (sodium chloride).

Therefore, we recommend that the **epilimnion** and the **tributaries** be sampled for chloride next year. This additional sampling may help us identify what areas of the watershed are contributing to the increasing in-lake conductivity.

*Please note that there will be an additional cost for each of the chloride samples and that these samples must be analyzed at the DES laboratory in Concord. In addition, it is best to conduct chloride sampling in the spring as the snow is melting and during rain events.*

➤ **Table 7a and Table 7b: Total Kjeldahl Nitrogen and Nitrite+Nitrate Nitrogen**

Table 7a in Appendix B presents the current year and historical Total Kjeldahl Nitrogen and Table 7b presents the current year and historical nitrite and nitrate nitrogen. Nitrogen is another nutrient that is essential for the growth of plants and algae. Nitrogen is typically the limiting nutrient in estuaries and coastal ecosystems. However, in freshwater, nitrogen is not typically the limiting nutrient. Therefore, nitrogen is not typically sampled through VLAP. However, if phosphorus concentrations in freshwater are elevated, then nitrogen loading may stimulate additional plant and algal growth. Please refer to the “Chemical Monitoring Parameters” section of this report for a more detailed explanation.

During the most recent DES Lake Assessment Program survey, which was conducted during Summer **1998**, the ratio of the total nitrogen concentration to total phosphorus (TN:TP) concentration in the epilimnion sample was **approximately 40**, which is **greater than 15**, indicating that the lake is **phosphorus-limited**. This means that any additional **phosphorus** loading to the pond will stimulate additional plant and algal growth.

➤ **Table 8: Total Phosphorus**

Table 8 in Appendix B presents the current year and historical total phosphorus data for in-lake and tributary stations. Phosphorus is the nutrient that limits the algae's ability to grow and reproduce. Please refer to the "Chemical Monitoring Parameters" section of this report for a more detailed explanation.

The total phosphorus concentration in the **#08 Fernalds A, #09 Fernalds B, Fernalds Upstream** samples continued to be **extremely elevated** this year. The turbidity of these samples was also **at least slightly elevated** on most sampling events.

In addition, the phosphorus concentration in the **Back Creek B, Fundy Brook, Mountain Brook, Round Pond Brook, and White Grove Brook** samples was at **least slightly elevated** on **at least one** sampling event this year. However, the turbidity of each sample was not **particularly elevated**.

Due to the unusually high water levels and amount of rainfall during the spring and summer of **2006**, it is possible that wetland systems in this area of the watershed were releasing phosphorus-enriched water into the tributaries and ultimately into the lake.

If you suspect that erosion is occurring in any area of the watershed, we recommend that your monitoring group conduct a stream survey and rain event sampling along the tributaries. This additional sampling may allow us to determine what is causing the **elevated** levels phosphorus.

*For a detailed explanation on how to conduct rain event sampling and stream surveys, please refer to the 2002 VLAP Annual Report special topic article, which is posted on the VLAP website at [http://www.des.nh.gov/wmb/vlap/2002/documents/Appndxd\\_monit\\_oring.pdf](http://www.des.nh.gov/wmb/vlap/2002/documents/Appndxd_monit_oring.pdf), or contact the VLAP Coordinator.*

➤ **Table 9 and Table 10: Dissolved Oxygen and Temperature Data**

Table 9 in Appendix B shows the dissolved oxygen/temperature profile(s) collected during **2006**. Table 10 in Appendix B shows the historical and current year dissolved oxygen concentration in the hypolimnion (lower layer). The presence of dissolved oxygen is vital to fish and amphibians in the water column and also to bottom-dwelling organisms. Please refer to the “Chemical Monitoring Parameters” section of this report for a more detailed explanation.

The dissolved oxygen concentration was ***much lower in the hypolimnion (lower layer) than in the epilimnion (upper layer)*** at both deep spots on the **August** sampling event. As stratified lakes age, and as the summer progresses, oxygen typically becomes ***depleted*** in the hypolimnion by the process of decomposition. Specifically, the reduction of hypolimnetic oxygen is primarily a result of biological organisms using oxygen to break down organic matter, both in the water column and particularly at the bottom of the lake where the water meets the sediment. When hypolimnetic oxygen concentration is depleted to less than 1 mg/L, ***as it was on the annual biologist visit this year at the South deep spot and on many previous annual visits to both deep spots***, the phosphorus that is normally bound up in the sediment may be re-released into the water column, a process referred to as ***internal phosphorus loading***.

Since an internal source of phosphorus in the lake is likely present, it is even more important that watershed residents act proactively to minimize phosphorus loading from the watershed.

*Please note that due to windy conditions on the August sampling event, the upper portion of the North Station deep spot dissolved oxygen profile was not reported since the results were not representative.*

➤ **Table 11: Turbidity**

Table 11 in Appendix B lists the current year and historical data for in-lake and tributary turbidity. Turbidity in the water is caused by suspended matter, such as clay, silt, and algae. Water clarity is strongly influenced by turbidity. Please refer to the “Other Monitoring Parameters” section of this report for a more detailed explanation.

As discussed previously, the hypolimnetic turbidity at both deep spots this year continued to be ***at least slightly elevated*** on most sampling events. This suggests that the lake bottom is covered by a thick organic layer of sediment that is easily disturbed. When the lake bottom is disturbed, sediment, which typically contains attached phosphorus, is released into the water column. When collecting the

hypolimnion sample, make sure that there is no sediment in the Kemmerer Bottle before filling the sample bottles.

Also discussed previously, the turbidity and total phosphorus concentration in the **#08 Fernalds A, #09 Fernalds B, Fernalds Upstream** samples continued to be **elevated** this year, which suggests that erosion is occurring in these areas of the watershed.

If you suspect that erosion is occurring in this area of the watershed, we recommend that your monitoring group conduct a stream survey and rain event sampling along this tributary. This additional sampling may allow us to determine what is causing the **elevated** levels of turbidity.

*For a detailed explanation on how to conduct rain event sampling and stream surveys, please refer to the 2002 VLAP Annual Report special topic article, which is posted on the VLAP website at [http://www.des.nh.gov/wmb/vlap/2002/documents/Appndxd\\_monit\\_oring.pdf](http://www.des.nh.gov/wmb/vlap/2002/documents/Appndxd_monit_oring.pdf), or contact the VLAP Coordinator.*

➤ **Table 12: Bacteria (*E.coli*)**

Table 12 in Appendix B lists the current year and historical data for bacteria (*E.coli*) testing. *E. coli* is a normal bacterium found in the large intestine of humans and other warm-blooded animals. *E.coli* is used as an indicator organism because it is easily cultured and its presence in the water, in defined amounts, indicates that sewage **may** be present. If sewage is present in the water, potentially harmful disease-causing organisms **may** also be present.

Bacteria sampling was **not** conducted during **2006**. If residents are concerned about sources of bacteria such as failing septic systems, animal waste, or waterfowl waste, it is best to conduct *E. coli* testing when the water table is high, when beach use is heavy, or immediately after rain events.

➤ **Table 13: Chloride**

Table 13 in Appendix B lists the current year and the historical data for chloride sampling. The chloride ion (Cl<sup>-</sup>) is found naturally in some surfacewaters and groundwaters and in high concentrations in seawater. Research has shown that elevated chloride levels can be toxic to freshwater aquatic life. In order to protect freshwater aquatic life in New Hampshire, the state has adopted **acute and chronic** chloride criteria of **860 and 230 mg/L** respectively. The chloride content in New Hampshire lakes is naturally low, generally less than 2 mg/L in surface waters located in remote areas away from

habitation. Higher values are generally associated with salted highways and, to a lesser extent, with septic inputs. Please refer to the “Chemical Monitoring Parameters” section of this report for a more detailed explanation.

Chloride sampling was **not** conducted during **2006**.

➤ **Table 14: Current Year Biological and Chemical Raw Data**

Table 14 in Appendix B lists the most current sampling year results. Since the maximum, minimum, and annual mean values for each parameter are not shown on this table, this table displays the current year “raw,” meaning unprocessed, data. The results are sorted by station, depth, and then parameter.

➤ **Table 15: Station Table**

As of the spring of 2004, all historical and current year VLAP data are included in the DES Environmental Monitoring Database (EMD). To facilitate the transfer of VLAP data into the EMD, a new station identification system had to be developed. While volunteer monitoring groups can still use the sampling station names that they have used in the past and are most familiar with, an EMD station name also exists for each VLAP sampling location. Table 15 in Appendix B identifies what EMD station name corresponds to the station names you have used in the past and will continue to use in the future.

## **DATA QUALITY ASSURANCE AND CONTROL**

### **Annual Assessment Audit:**

During the annual visit to your lake, the biologist conducted a sampling procedures assessment audit for your monitoring group. Specifically, the biologist observed the performance of your monitoring group while sampling and filled-out an assessment audit sheet to document the ability of the volunteer monitors to follow the proper field sampling procedures, as outlined in the VLAP Monitor’s Field Manual. This assessment is used to identify any aspects of sample collection in which volunteer monitors failed to follow proper procedures, and also provides an opportunity for the biologist to retrain the volunteer monitors as necessary. This will ultimately ensure that the samples that the volunteer monitors collect are truly representative of actual lake and tributary conditions.

Overall, your monitoring group did an **excellent** job collecting samples on the annual biologist visit this year! Specifically, the members of your monitoring group followed the proper field sampling procedures and there was no need for the biologist to provide additional training. Keep up the good work!

### **Sample Receipt Checklist:**

Each time your monitoring group dropped off samples at the laboratory this summer, the laboratory staff completed a sample receipt checklist to assess and document if your group followed proper sampling techniques when collecting the samples. The purpose of the sample receipt checklist is to minimize, and hopefully eliminate, future re-occurrences of improper sampling techniques.

Overall, the sample receipt checklist showed that your monitoring group did an **excellent** job when collecting samples and submitting them to the laboratory this year! Specifically, the members of your monitoring group followed the proper field sampling procedures and there was no need for the laboratory staff to contact your group with questions, and no samples were rejected for analysis.

### **USEFUL RESOURCES**

*Acid Deposition Impacting New Hampshire's Ecosystems*, DES fact sheet ARD-32, (603) 271-2975 or [www.des.nh.gov/factsheets/ard/ard-32.htm](http://www.des.nh.gov/factsheets/ard/ard-32.htm).

*Best Management Practices to Control Nonpoint Source Pollution: A Guide for Citizens and Town Officials*, DES Booklet WD-03-42, (603) 271-2975.

*Canada Geese Facts and Management Options*, DES fact sheet BB-53, (603) 271-2975 or [www.des.nh.gov/factsheets/bb/bb-53.htm](http://www.des.nh.gov/factsheets/bb/bb-53.htm).

*Cyanobacteria in New Hampshire Waters Potential Dangers of Blue-Green Algae Blooms*, DES fact sheet WMB-10, (603) 271-2975 or [www.des.nh.gov/factsheets/wmb/wmb-10.htm](http://www.des.nh.gov/factsheets/wmb/wmb-10.htm).

*Erosion Control for Construction in the Protected Shoreland Buffer Zone*, DES fact sheet WD-SP-1, (603) 271-2975 or [www.des.nh.gov/factsheets/sp/sp-1.htm](http://www.des.nh.gov/factsheets/sp/sp-1.htm).

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